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Fatty liver hemorrhagic syndrome (FLHS) continues to be a major cause of mortality among caged laying chickens. It ranked third (about 10%) following leukosis and cannibolism in those hens submitted to the Animal Disease Research and Diagnostic Laboratory in 1976. Five more experiments on this subject were completed this past year. One involved a normal feeding regime, while in four experiments the force-feeding technique was used.

In Experiment 2 (See A.S. Series 76-1 for Experiment 1) ad libitum feeding of corn, oats or wheat-soybean diets with 2 or 5% added fat were tested for thirteen 28-day periods using 360 hens. Three commercial strains of pullets that had been grown on a 12% protein, moderate energy diet were divided equally among five replicates (12 hens per rep).

In Experiments 3 and 4, attempts were made to force-feed isocaloric corn-soybean diets (14% protein) containing 2, 5 or 8% fat additions at about 125% of normal intake. Feed intake was more precisely controlled in Experiment 4. Five replicates (1 hen per rep) for a total of 30 hens were force-fed for 3 weeks.

In Experiment 5, a corn-soybean diet (14% protein, 2% fat) supplemented with choline and/or methionine was force-fed at about 125% of normal feed intake. Seven replicates (1 hen per rep) for a total of 56 hens were force-fed for 3 weeks.

In Experiment 6, corn-soybean or oat-soybean diets supplemented with or without choline were force-fed at about 125% of normal feed intake. Five replicates (1 hen per rep) for a total of 40 hens were force-fed daily for 3 weeks. Hens on the force-feeding experiments had been on a 16% protein layer diet prior to the start of the trial.

Several of the production parameters and the liver data are shown in Tables 1 and 3 for Experiment 2. The most striking difference was the low level of liver fat in birds on the oat diets. The higher fat level (5%) resulted in significantly lower feed consumption without greatly altering other parameters.

Table 3 shows some of the production and liver parameters for Experiments 3 and 4. In general, the force-fed birds showed the symptoms of FLHS. The decreased egg production, increased weight gains, increased liver weight and liver fat show the striking characteristics of the disease. With the force-fed hens, increasing levels of dietary fat resulted in lower liver lipid levels.

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[1]Superintendent, Poultry Research Center, and Professor and Leader, Poultry Research and Extension, respectively.

The production and liver parameters for Experiment 5 are shown in Table 4. The force-fed birds again show the typical symptoms of FLHS. Choline additions decreased liver lipids in the ad libitum hens but not for force-fed hens. Supplemental methionine did not decrease lipid levels.

Table 5 shows the production and liver parameters for Experiment 6. Severe decreases in egg production were noted for hens on the oat diets fed ad libitum due to the drastic dietary change and decreased feed intake. A drop in production was not noted with the force-fed hens, apparently because the hens were forced to consume enough calories to maintain production. Liver lipids were low in the control hens. However, hens on the force-fed corn diets showed FLHS. None of the hens on the oat diet showed signs of FLHS. Some factor in oats apparently gives protection even when feed consumption is extremely high. Choline again showed some benefit in mobilizing liver lipids.

Table 1. Effects of Diet on Production Parameters With Ad Libitum Feeding (Experiment 2)

	Hen-day production[1]	Feed intake	Average egg weight	Final body weight
	(%)	(g./hen/day)	(g.)	(kg.)
Corn	67.5[a2]	96.2	62.5[b]	1.81[a]
Oats	59.2[b]	93.6	63.4[a]	1.66[b]
Wheat	60.8[b]	96.7	59.2[c]	1.64[b]
2% fat	63.5	98.8[a]	61.8	1.69
5% fat	63.0	92.2[b]	61.5	1.71

[1] Thirteen 28-day periods.
[2] Data with different superscripts differ at the 1% level of significance.

Table 2. Effects of Diet and Strain on Liver Parameters With Ad Libitum Feeding

	Average liver weight (g.)	Average liver score[1]	Average liver fat (%)	Average total liver fat (g.)
Corn	44.4	1.8	12.7	6.1
Oats	36.9	1.0	5.5	2.1
Wheat	42.9	1.9	14.9	6.9
2% fat	41.4	1.5	10.3	4.8
5% fat	41.4	1.6	11.8	5.2
Strain 1	40.9	1.3	11.6	5.3
2	42.4	2.1	11.9	5.6
3	40.9	1.4	9.6	4.2

[1] 1 = no hemorrhages, 2 = 1 to 10 hemorrhages, 3 = 10 to 25 hemorrhages and 4 = greater than 25 hemorrhages.

Table 3. Effects of Force Feeding Corn Diets of Three Fat Levels on Production and Liver Parameters (Experiments 3 and 4, Strain 4, 30 and 48 Weeks of Age, Respectively)

	Hen-day production (21 days) (%)	Feed intake (g./hen/day)	Average egg weight (g.)	Average weight gain (g.)	Average liver weight (g.)	Average liver score[1]	Total liver fat (g.)
			Experiment 3				
Ad libitum							
2% fat	90	115	60	140	43	1.0	4.8
5% fat	92	118	59	160	51	1.0	8.9
8% fat	90	111	58	100	41	1.0	4.4
Force-fed							
2% fat	79	131	67	380	70	2.6	16.4
5% fat	63	128	63	360	66	1.6	15.6
8% fat	84	134	61	300	60	1.4	13.4
			Experiment 4				
Ad libitum							
2% fat	80	104	62	20	42	1.4	4.8
5% fat	72	102	67	20	44	1.6	5.2
8% fat	81	100	63	10	43	1.8	6.5
Force-fed							
2% fat	54	125	67	270	68	2.6	18.1
5% fat	57	125	65	350	59	2.0	16.8
8% fat	43	125	67	190	49	2.4	6.8

[1] See Table 2.

Table 4. Effects of Force Feeding Corn Diets With Supplemented Choline or Methionine on Production and Liver Parameters (Experiment 5, Strain 4, 66 Weeks of Age)

	Hen-day production (21 days)	Feed intake	Average egg weight	Average weight gain	Average liver weight	Average liver score[1]	Total liver fat
	(%)	(g./hen/day)	(g.)	(g.)	(g.)		(g.)
Ad libitum							
Control	74	130	65.3	-200	51	1.1	9.6
Control + choline[2]	78	115	60.6	0	42	1.6	5.2
Control + methionine[3]	85	132	66.3	0	50	1.7	8.9
Control + choline + methionine	87	111	67.5	0	43	1.6	5.3
Force-fed							
Control	68	145	70.2	200	67	1.9	18.9
Control + choline	68	154	72.8	100	87	3.1	26.6
Control + methionine	66	149	71.6	200	107	3.6	40.6
Control + choline + methionine	77	149	67.1	200	82	2.4	25.4

[1] See Table 2.
[2] 1500 mg./kg.
[3] 0.1%.

Table 5. Effects of Force Feeding Corn and Oat Diets With Choline Supplementation on Production and Liver Parameters (Experiment 6, Strain 4, 73 Weeks of Age)

	Hen-day production (21 days)	Feed intake	Average egg weight	Average weight gain	Average liver weight	Average liver score[1]	Total liver fat
	(%)	(g./hen/day)	(g.)	(g.)	(g.)		(g.)
Ad libitum							
Corn	72	102	64	-100	35	1.2	3.2
Oats	36	78	62	-140	27	1.0	0.6
Corn + choline[1]	80	100	66	-160	33	1.0	1.1
Oats + choline	40	98	66	-70	32	1.0	0.7
Force-fed							
Corn	75	155	72	250	94	3.0	33.8
Oats	75	155	71	210	51	1.0	5.9
Corn + choline	56	150	65	380	83	2.8	22.7
Oats + choline	65	166	68	100	62	1.0	9.6

[1] 1500 mg./kg.